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# Impact of Tip Moth injury on Growth and Yield of 16-Year-Old Loblolly and Shortleaf Pine

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## SUMMARY

*For the first six growing seasons,* **47 loblolly** *and shortleaf pine* **plots** *throughout the South were treated to protect them against tip moth (at first with DDT and later with a granular phora* **te).** *Treatments provided good protection, and in the* **early** *years treated trees appeared to outgrow untreated trees. But by age 16 there were no substantial differences in height or diameter except at one* **location. Overall,** *treatment increased the* **loblolly** *yield 3.9 cords per acre and the* **shortleaf** *yield 0.4 cord per acre. At current* **stumpage** *prices, such an increase* in yield would not *provide enough economic gain to justify treatment.*

Additional keywords: Pinus taeda, P. echinata, forest management, pesticide use.

Attacks by the pine tip moth Rhyacionia spp. kill the growing tips of young loblolly (Pinus (P. echinatad shortleaf Mill.) pine. But how serious is the nomic impact on the trees' long-term growth and yield? Beal (1967) reported that in the Midsouth loblolly and shortleaf plantation trees protected from tip moths significantly outgrew attacked trees at some locations during the first 6 years after planting. We examined these same plantations 9 years later to determine if the early growth advantage of protected trees continued and to see if the increase in volume justified the expense of treatment.

## METHODS

In 1959-1960, four plots were planted at each of eight locations: Brewton, Alabama; Gulfport, Mississippi; Harrison, Arkansas; Many, Louisiana; Marianna, Florida; Nacogdoches, Texas; Oxford, Mississippi; and Sewanee, Tennessee. At Crossett, Arkansas, six plots were planted, and at Alexandria, Louisiana, nine plots were planted. Each plot was divided into two subplots. One was planted with shortleaf and the other with loblolly pine, except that at Alexandria no shortleaf was planted. Furthermore, at Marianna half the area was prepared by chopping and half by rootraking, thus nullifying the opportunity for replication of treatments.

At most locations half the plots were repeatedly treated with insecticide to prevent tip moth attack, and half were left unprotected. However, at Alexandria three plots were treated once at the beginning of each growing season, three were treated

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at monthly intervals, and three were left untreated as a check.

In 1959, a 5-percent water emulsion of DDT was sprayed on the study trees several times during the early part of the growing season. During the second and third growing seasons, a 2-percent water emulsion of DDT was applied at about monthly intervals. Research in 1959-1961 indicated that systemic insecticides offered promise in eliminating the critical timing involved with the use of DDT and other contact insecticides (Treece and Mathyssee 1959, Barras et al. 1967). Therefore, in the fourth, fifth, and sixth growing seasons, 10 grams of lo-percent granular phorate were sprinkled on the soil around each tree in early spring. (Neither pesticide is now acceptable, but Cygon, Di-Syston, and Guthion are registered for use.[1]) These treatments prevented tip moth damage.

Each subplot was planted with 81 trees at 7- by 9-foot spacing. The inner 25 trees were the measurement trees. For the first 5 or 6 years, they were examined at the end of each growing season to determine height growth and tip moth infestation.

Because the main terminals are the most important, attacks on them were used to classify severity of infestation:

| Percent of main terminals infested | Severity of at tack |
|---|---|
| 1-10 | very light |
| 11-40 | light |
| 41-70 | medium |
| ‘I-100 | heavy |

The number of larvae in each terminal was recorded at the end of the growing season. Single attack was defined as one or two insects per tip, multiple as more than two. Trees were examined at the end of the growing season because it was impractical to do so after each generation of moths. There can be as many as five generations a year along the Gulf Coast.

At the end of the 15th growing season in the field, the d.b.h. of each tree was measured with a diameter tape, and its height was determined with a clinometer or hypsometer. Local volume tables were developed giving cubic volumes inside bark to a S-inch top d.i.b. for all trees 3.6 inches in d.b.h. and larger. Plot volumes ($ft^3$) were converted to a per acre basis by multiplying by 27.7. These were in turn converted to cords by dividing by 75.

Differences in cubic volumes per acre and average heights were tested for significance at the 90-percent level of confidence by analyses of variance. Data from the Many, Louisiana, plots were not included in the analyses because the treated plots had only been sprayed the first year; nor were data from the Alexandria plots included because there were no shortleaf plots in this installation.

## RESULTS AND DISCUSSION

By age 16, tip moth attack had produced a substantial height loss only at Marianna, Florida, where treated trees averaged 9 to 15 feet taller than controls (table 1). At all other locations, height growth during the 9 to 10 years after pesticide treatments ceased was virtually the same for treated and untreated trees.

Average tree diameters differed by only 0 to 0.5 inch at all locations except Marianna, where treated trees averaged up to 1.3 inches bigger than controls (table 2). Apparently, diameter growth was influenced as much by stocking differences as by tip moth attack. Furthermore, the high site quality of many installations (a number had site indexes above 100 feet at age 50 for loblolly) assured good diameter growth regardless of treatment.

These findings agree with those of Warren and others (1975a, p. 23 and 1975b, p. 26):

> Data collected through the 13th year indicate that although trees that are protected from tip moth and competing vegetation show superior early growth, the rate of growth subsequently becomes equal in treated and untreated trees, though initial advan-

[1]Mention of trade names if for identification only and does not imply endorsement by the U.S. Department of Agriculture.

Table 1.– Degree of tip moth attack after 5 or 6 *growing seasons, in the field and its* effect *on tree height after 15 growing seasons.*

| Location | Severity of attack on untreated trees | Type of attack | Tree height at age 16 | | |
|---|---|---|---|---|---|
| | | | Treated | Untreated | Difference |
| | | | - - - - - | *Feet* | - - - - - |
| Loblolly pine - 6th year | | | | | |
| Crossett, AR | Heavy | Multiple | 39 | 39 | 0 |
| Oxford, MS | Medium | Multiple | 52 | 47 | 5 |
| Loblolly pine - 5th year | | | | | |
| Alexandria, LA | Medium | Multiple | 47 | 44 | 3 |
| Brewton, AL | Medium | Single | 44 | 45 | -1 |
| Gulfport, MS | Very Light | Single | 46 | 46 | 0 |
| Harrison, AR | Very Light | Single | 36 | 35 | 1 |
| Marianna, FL[1] | Medium | Single | 36 | 21 | 15 |
| Marianna, FL[2] | Medium | Single | 26 | 16 | 10 |
| Nacogdoches, TX | Medium | Multiple | 51 | 48 | 3 |
| Sewanee, TN | Very Light | Single | 45 | 45 | 0 |
| Shortleaf pine - 6th year | | | | | |
| Crossett, AR | Heavy | Multiple | 35 | 33 | 2 |
| Oxford, MS | Medium | Multiple | 40 | 39 | 1 |
| Shortleaf pine - 5th year | | | | | |
| Brewton, AL | Medium | Single | 45 | 45 | 0 |
| Gulfport, MS | Very Light | Single | 44 | 44 | 0 |
| Harrison, AR | Very Light | Single | 28 | 29 | -1 |
| Marianna, FL[1] | Medium | Single | 27 | 18 | 9 |
| Marianna, FL[2] | Medium | Single | 17 | 15 | 2 |
| Nacogdoches, TX | Medium | Multiple | 45 | 41 | 4 |
| Sewanee, TN | Very Light | Single | 39 | 39 | 0 |

[1] Site prepared by chopping.
[2] Site prepared by rootraking.

tages in height and diameter remain to some extent. Whether this initial growth advantage represents significant economic gains is not clear....

Tree measurements made in October, 1975, following completion of the 16th growing season, indicate that earlier differences detected between trees in the treated and untreated plots are no longer so obvious.

In the present study, mean height averaged over all plots was 42.6 feet for treated loblolly and 38.0 feet for controls. Means for shortleaf were 36.6 feet for treated trees and 34.9 feet for controls. In each species, the difference in height was significant.

Plot volume averaged 2,130 $ft^3$ for treated loblolly and 1,837 $ft^3$ for untreated loblolly, 1,472 $ft^3$ for treated shortleaf and

**Table** *2.-Effect of tip moth control on d.b.h., basal area, and cubic volume after 15 growing seasons in the field.*

| | Trees surviving | | . . . | | Basal Area | | Cubic volume | | |
|---|---|---|---|---|---|---|---|---|---|
| | Treated | Untreated | Treated | Untreated | Treated | Untreated | Treated | Untreated | Difference |
| | . . . No./acre . . . | | . . . Inches . . . | | . . . $Ft^2$/acre . . . | | . . . . . . Cords/acre | | . . . . . |
| Loblolly pine | | | | | | | | | |
| Alexandria, LA | 646 | 674 | 6.4 | 6.4 | 148 | 151 | 32.5 | 29.7 | + 2.8 |
| Alexandria, LA[1] | 665 | 674 | 6.0 | 6.4 | 147 | 151 | 31.7 | 29.7 | + 2.0 |
| Brewton, AL | 498 | 651 | | 5.9 | 98 | 123 | 21.5 | 26.2 | - 4.7 |
| Crossett, AR | 629 | 646 | 6.6 | 6.4 | 150 | 145 | 23.2 | 22.5 | + .7 |
| Gulfport, MS | 498 | 554 | 7.2 | 6.9 | 143 | 145 | 31.5 | 32.9 | - 1.4 |
| Harrison, AR | 586 | 576 | 6.9 | 6.6 | 152 | 125 | 23.2 | 17.9 | + 5.3 |
| Many, LA | 596 | 526 | 6.9 | 7.2 | 157 | 148 | 38.6 | 37.0 | + 1.6 |
| Marianna, FL[2] | 581 | 609 | 5.4 | 3.6 | 92 | 43 | 11.1 | 2.0 | + 9.1 |
| Marianna, FL[3] | 637 | 581 | 4.2 | 2.9 | 61 | 27 | 5.0 | 0.7 | + 4.3 |
| Nacogdoches, TX | 512 | 434 | 7.1 | 6.8 | 144 | 108 | 36.7 | 24.7 | +10.0 |
| Oxford, MS | 595 | 595 | 7.5 | 7.2 | 183 | 169 | 49.7 | 37.9 | +11.8 |
| Sewanee, TN | 512 | 526 | 7.8 | 7.5 | 169 | 161 | 36.1 | 34.8 | + 1.3 |
| Shortleaf pine | | | | | | | | | |
| Brewton, AL | 568 | 665 | 6.0 | 8.2 | 111 | 140 | 20.6 | 28.4 | - 7.8 |
| Crossett, AR | 489 | 517 | 6.1 | 5.7 | 98 | 92 | 15.5 | 13.4 | + 2.1 |
| Gulfport, MS | 568 | 609 | 5.4 | 6.6 | 145 | 146 | 31.9 | 30.1 | + 1.8 |
| Harrison, AR | 491 | 525 | 6.3 | 5.4 | 78 | 77 | 10.0 | 9.4 | + 0.6 |
| Many, LA | 610 | 568 | | 5.8 | 130 | 103 | 28.6 | 29.5 | + 8.1 |
| Marianna, FL[2] | 665 | 665 | 4.8 | 3.9 | 83 | 56 | 7.8 | 4.1 | + 3.7 |
| Marianna, FL[3] | 637 | 471 | 3.0 | 3.0 | 32 | 24 | 1.0 | 0.8 | + 0.2 |
| Nacogdoches, TX | 610 | 664 | 6.6 | 6.9 | 144 | 174 | 34.8 | 34.7 | + 0.1 |
| Oxford, MS | 692 | 678 | 6.2 | 6.3 | 145 | 148 | 27.5 | 25.7 | + 1.8 |
| Sewanee, TN | 458 | 430 | 5.9 | 5.4 | 88 | 56 | 16.3 | 12.3 | + 4.0 |

[1] Treated only once a year.
[2] Site prepared by chopping.
[3] Site prepared by rootraking.

1,440 $ft^3$ for untreated shortleaf. The difference between treatments was significant for loblolly but not for shortleaf. Overall, treatment increased the loblolly yield 3.9 cords per acre and the shortleaf yield 0.4 cord per acre.

The economic implications of tip moth damage in most plantations appear to be minimal. Loblolly pulpwood stumpage in Louisiana is now worth $6.55 per cord. Treatment has increased our loblolly stumpage return, if clearcut at age 16, by $25.54 per acre (volume increase of 3.9 cords per acre x $6.55 per cord). If we discount this increase back 15 years at 6 or 8 percent, we find that our break-even investment in tip moth control during the first growing season in the field would be $10.65 at 6 percent or $8.05 at 8 percent per acre to pay for 5 or 6 years of protection. Although treatment cost records were not kept, it is reasonable to assume that we could not do the work for $8.05 to $10.65 per acre. Possibly differences in yield would have been greater had treatment been continued longer; nevertheless, we believe the chemical treatments did not pay off.

To effectively control tip moth damage at a reasonable price, we need a controlled-release systemic pesticide that remains active for several years. Lacking such a chemical, we must rely on continued refinement of silvicultural techniques and genetic selection for tip moth resistance. The periodicity of tip moth infestations and its causes also need further study. In the Lower Coastal Plain where tip moths are a problem, slash pine can be planted in place of loblolly.

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